1,175,993

PATENT SPECIFICATION 1,175,993

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION.

Packaging Articles.

We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America, of 343 State Street, Rochester, New York 14650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a curtain coating method for packaging articles by coating them with a plastic sheet or film.

All sorts of consumer articles, inluding food, toys, hardware, toilet goods, and the like are merchandised in plastic packages. These packages include containers moulded to fit the article, packages in which film is wrapped around the article, or it may be a combination package made from plastics and another material such as paper, metal foil, and the like. In most instances, the plastic material permits the consumer to see the article which is packaged. Thus, the plastic material serves as a complete covering or as a window or blister formed in a package made of some other material. One of the more recent trends in packaging is to mount the article on a substrate and to apply a plastic film as a coating over the article and the substrate to bind the article to the substrate in a transparent covering. The present invention is concerned with an improvement in the method of packaging articles mounted on a substrate or backing sheet and held to that substrate by a coating of plastic material which conforms very closely to the outer shape of the article being packaged, the coating being formed by a falling curtain of molten plastic material rather than a preformed film which must be treated to cause it to shrink or otherwise form it in place.

In accordance with the present invention there is provided a curtain coating method of packaging an article on a substrate comprising forming a coatable assembly of at least one article superposed on an air-permeable substrate positioned upon a receiving member of a radially disposed group of horizontally rotatable support means adapted to provide a vacuum to the underneath surface of the air-permeable substrate, reducing the air pressure beneath the substrate sufficiently to produce enough suction at the upper surface of the substrate to assist in immobilizing the article, indexing the curtain coatable assembly into a curtain coating station, maintaining a reduced air pressure beneath the substrate, moving a falling curtain of a viscous molten thermoplastic coating composition over the curtain coatable assembly to cover the exposed upwardly and outwardly facing surfaces of the substrate and the articles supported thereon with a shape-conforming film, thereby binding the articles to the substrate to form at least one packaged article as the film cools and solidifies, indexing the coated assembly out of the coating station, and maintaining at least a portion of the reduced air pressure underneath the substrate until the film solidifies, and removing the coated assembly, leaving a receiving member available for reuse.

The method of curtain coating according to the present invention will now be described with reference to the accompanying drawings, in which:—

Fig. 1 is an elevation of one form of curtain coating apparatus for carrying out

the method according to the present invention;

Fig. 2 is a plan of a part of the apparatus shown in Fig. 1;

Fig. 3 is a plan, to an enlarged scale, of the central portion of the apparatus shown in Fig. 2; and

Fig. 4 is a cross-section taken on the line IV—IV of Fig. 3.

As shown in Figs. 1 and 2, articles 1 to be coated are placed on an air-permeable substrate 2 to form a coatable assembly which is to be coated by a curtain 8 of molten thermoplastic material extruded from a die orifice 7 in an overhead reciprocating die 5, containing molten thermoplastic material 6. Die 5 moves with a reciprocating motion, as indicated by the arrow 9, from its position at 5 to the other limit of its travel at 5*a*. Die 5 may use any known method of travel, that which is indicated in Fig. 1 being a rail 10 cooperating with wheels 11 attached to the die 5. A molten thermoplastic material 6 is maintained and supplied to the die 5 through a feed line 12 from a reservoir 13. The ultimate source of supply of molten thermoplastic material is an extruder 14 which converts solid thermoplastic material fed into a hopper 15, into a molten mass of the proper consistency. When the molten thermoplastic material in the falling curtain 8 is not being used to coat articles 1 and substrate 2, it is caught in a collector 16 located immediately below the die 5 and movable therewith as the die travels with reciprocating motion to the position 5*a* and back. The molten thermoplastic material collected in the collector 16 is conducted through a line 17 to a pump 18 and thence through a return line 19 to the reservoir 13 for recycling. All of the equipment and conduits from the collector 16 to the reservior 13 and on to the die 5 is normally insulated and heated to maintain the thermoplastic material at the proper molten consistency.

In the application of the thermoplastic coating to articles 1 located on substrate 2, the die 5 moves from one limit of its travel to the other limit 5*a* or in the reverse direction from 5*a* back to 5, trailing the curtain 8 behind it as it moves and permitting that curtain to fall upon the upward and outwardly exposed surfaces of articles 1 and substrate 2. When the coating operation is accomplished during the movement of the die from position 5 to position 5*a*, the sequence of operations is as follows. Curtain 8 is formed by molten plastic material falling through die orifice 7 into collector 16 without contacting any portion of substrate 2 and articles 1. As die 5 begins its motion toward position 5*a*, curtain 8 contacts the leading edge 20 of substrate 2 and, at the same time, a hot wire moves from location 21 to location 21*a* severing the curtain so that the lower portion of molten plastic material falls into collector 16 and is separated from the upper portion forming the coating on articles 1 and substrate 2. Die 5 moves with sufficient speed to cause curtain 8 to trail behind and to form a contact angle 22 with the upper surface of substrate 2 of not greater than about 45° and preferably not greater than about 30°. When the die reaches its final position at 5*a*, curtain 8 begins to fall vertically as shown at 8*a* and a second hot wire moves from position 23 to position 23*a* to sever curtain 8*a* so that the coating on articles 1 and substrate 2 is separated from curtain 8*a* which falls into collector 16*a*. The die at 5*a* is now ready for coating the next succeeding coatable assembly of articles and a substrate during its movement in the reverse direction to position 5; or, alternatively, the die at 5*a* may be returned to its position at 5 before coating the next coatable assembly.

In order to apply a snug coating around articles 1 and against the upper surface of substrate 2, a vacuum is applied to the lower surface of substrate 2. This vacuum is transmitted through the permeable structure of substrate 2 to the upper surface thereof to form a suction at that surface. A receiving member 3 is a hollow, shallow vessel with its upper surface or edges adapted to receive and support substrate 2. The exact construction of receiving member 3 is not critical and may take any of several forms. For example, it may be formed with a screen or a slotted structure across its upper, open area to provide support for substrate 2; or, alternatively, it may be formed without any supporting structure across the open area and merely have its upper edges fashioned with L-shaped means for receiving the edges of substrate 2. In any event, the upper, open area of receiving member 3 must be designed to permit the application of a vacuum to substantially all of the underneath surface of substrate 2, or, at the very least, to that portion of the underneath surface which lies beneath articles 1. The vacuum is communicated to the hollow interior of receiving member 3 through hollow, internal conduits in arms 24 connected to a central support 25. A vacuum producing means (not shown) is connected by means of a line 47 to a large vacuum tank 26 which serves to smooth the cycles of use and non-use of the vacuum, and thence through internal passageways 28, 37, or 38 to the interior conduits in arms 24. A servo valve 27 is an optional control device which may be inserted between tank 26 and internal passageways 28, 37, or 38 to provide a greater latitude in the precise timing involved in turning the vacuum on and off for the most efficient operation of coating.

As may be seen in Fig. 2, there are four identical arms 24 each terminating at one end in an identical receiving member 3 and each having its other end secured to a bearing support 29. The angular design of arms 24 is to permit the coating operation to take place with a minimum of the molten thermoplastic coating material falling on the arms 24, thereby obviating frequent cleaning. The exact number of arms 24 depends upon the design of the production line for any particular coating operation. In Fig. 2, the coating takes place at station A, unloading of the coating substrate takes place at station B, loading of a substrate 2 takes place at station C, and placing of articles 1 on substrate 2 takes place at station D, thus preparing it for coating at station A.

The bearing support 29, together with arms 24 and receiving members 3 revolves in a counter-clockwise direction (as indicated by arrow 32) about a fixed support 25 for indexing the receiving members 3 from one station to another. As illustrated, this structure is rotatably driven by means of a chain drive including a sprocket 30, a chain 31, a driving sprocket 33 and a power means (not shown).

In Figs. 3 and 4, the central support and bearing structure, along with the valves for the vacuum application, may be seen. The bearing support 29 fits snugly over the upper end of fixed support 25, the surfaces of these two parts being such that a vacuum seal can be maintained while the two contacting surfaces rotate relative to each other. The upper portion 34 of bearing support 29 has a polygonal shape, the number of sides of which correspond to the number of arms 24 provided for this structure. In the case shown in these drawings, the shape of upper portion 34 is square since there are four arms 24. The lower portion 35 of the bearing support 29 is cylindrical in its outer configuration and carries on its surface the sprocket 30. The interior of upper portion 34 is separated from the interior of lower portion 35 by means of a wall 42, and upper portion 34 is further divided into several interior compartments 36, the number of such compartments corresponding to the number of arms 24. In the embodiment shown in these drawings, four compartments 36 are formed by interior walls 43 and 44. Each compartment 36 is totally enclosed except for two holes one of which 48 communicates with the interior of its adjoining arm 24, and the other of which 39 communicates with corresponding holes in fixed support 25.

For a structure with four arms 24, it has been found desirable, but not essential, that fixed support 25 be provided with three passageways which communicate with holes 39. Main passageway 28 provides the principal conduit for vacuum to be supplied during the coating operation (station A in Fig. 2). Initial vacuum passageway 37 is designed to provide a reduction in air pressure at station D, to assist in holding articles 1 in place and to begin the application of a vacuum which is needed in full strength at station A. Final vacuum passageways 38 is employed to maintain a vacuum on the assembly after it has been coated so as to maintain the forming pressure on the molten plastic curtain until it has solidified by cooling in air. Thus, in the operation of this device, the first reduction in air pressure is applied while the coatable assembly is at station D, the full strength of the vacuum is applied just prior to and through the operations in station A, and at least a partial vacuum is applied while the coated assembly moves to station B.

Passageways 28, 37, and 38 are interconnected by means of a passageway 45 and thence through a single outlet passageway 46 to servo valve 27 or directly to vacuum tank 26. Servo valve 27 is a desirable and convenient means for controlling the timing of opening and closing these passageways to the vacuum in tank 26 and, therefore, is a preferred arrangement. In a more elaborate system than is shown here, each of passageways 28, 37, and 38 might be separately attached to one or more servo valves rather than to be interconnected and attached to a single servo valve.

The number, and the configuration, of arms 24 may be varied widely. Three or two arms 24 are readily adapted to normal production lines. Another alternative is to employ magnets on the underneath side of substrate 2 to assist in holding articles 1 in place when those articles are magnetically attracted. Still another alternative is to employ a positioning device for positioning articles 1 on substrate 2 and to hold those articles in place until immediately before the coating operation.

The plastic materials which are employed in the process of this invention may be any of a variety of high molecular weight thermoplastic materials. These materials include those capable of exhibiting a viscosity of at least 25,000 centipoises and preferably from 35,000 to 150,000 centipoises in the molten condition. Included among such materials are polyolefins, cellulose esters, vinyl polymers, and the like. Among the preferred materials are cellulose acetate butyrate and cellulose acetate propionate, because of their inexpensiveness, ease of handling, and ability to produce a final product with an excellent appearance. Preferably, the curtain 8 has a dimension from its origin to the upper surface of the article 1 which is several times the height of the article and has a thickness at the orifice 7 which is several times its

thickness at the upper surface of the article 1.

WHAT WE CLAIM IS:—

1. A curtain coating method of packaging an article on a substrate comprising forming a coatable assembly of at least one article superposed on an air-permeable substrate positioned upon a receiving member of a radially disposed group of horizontally rotatable support means adapted to provide a vacuum to the underneath surface of the air-permeable substrate, reducing the air pressure beneath the substrate sufficiently to produce enough suction at the upper surface of the substrate to assist in immobilizing the article, indexing the curtain coatable assembly into a curtain coating station, maintaining a reduced air pressure beneath the substrate, moving a falling curtain of a viscous molten thermoplastic coating composition over the curtain coatable assembly to cover the exposed upwardly and outwardly facing surfaces of the substrate and the articles supported thereon with a shape-conforming film, thereby binding the articles to the substrate to form at least one packaged article as the film cools and solidifies, indexing the coated assembly out of the coating station and maintaining at least a portion of the reduced air pressure underneath the substrate until the film solidifies, and removing the coated assembly, leaving a receiving member available for re-use.

2. A method according to claim 1 wherein the curtain has a dimension from its origin to the upper surface of the article which is several times the height of the article and has a thickness at its origin which is several times its thickness at said surface of the article.

3. Method according to claim 1 or 2 wherein the falling curtain is moved over the coatable assembly at a rate sufficient to cause the curtain to form a contact angle with the upper surface of the substrate of not greater than 45°, preferably not greater than 30°.

4. Method according to claims 1, 2 or 3 wherein the molten thermoplastic composition has a viscosity of at least 25,000 centipoises, preferably between 35,000 and 150,000 centipoises.

5. Method according to any one of the preceding claims 1 to 4 wherein the coating composition is a cellulose ester.

6. Method according to any one of the preceding claims 1 to 4 wherein the coating composition is a polyolefin.

7. Curtain coating method according to claim 1 of packaging an article on a substrate, substantially as hereinbefore described.

8. A curtain coating apparatus for packaging articles on a substrate, constructed and adapted to operate substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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Agent for the Applicants.

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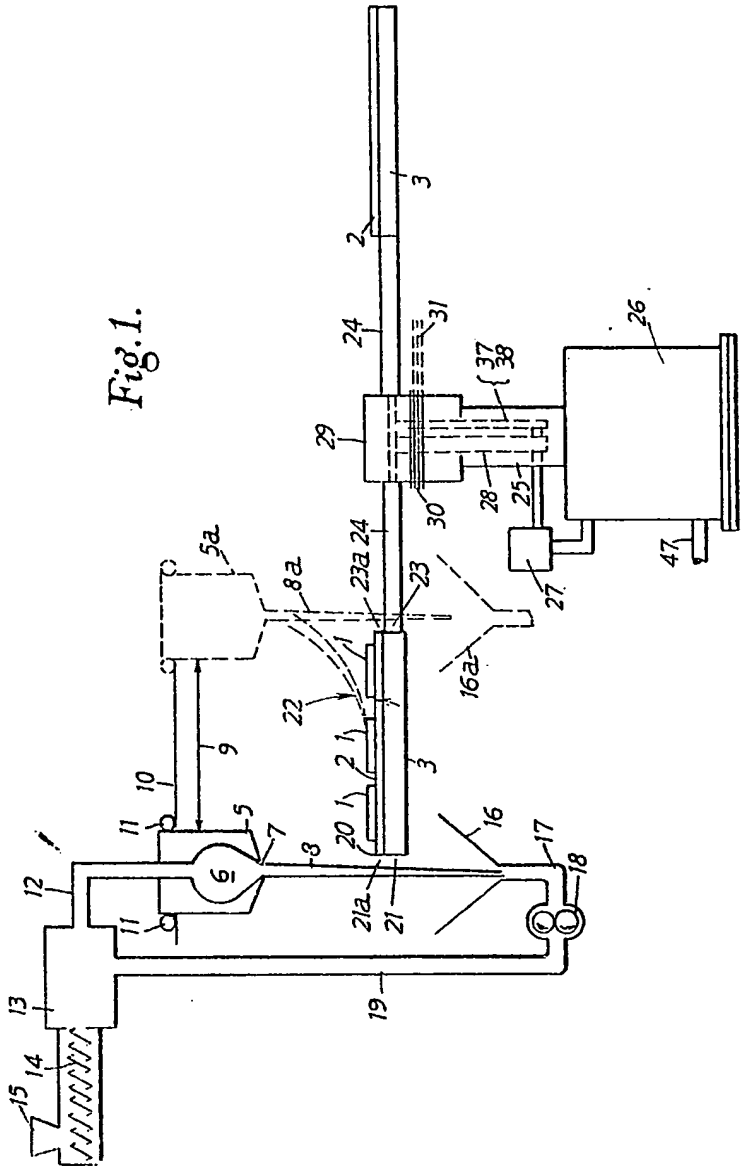
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig. 1.



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Sheet 2

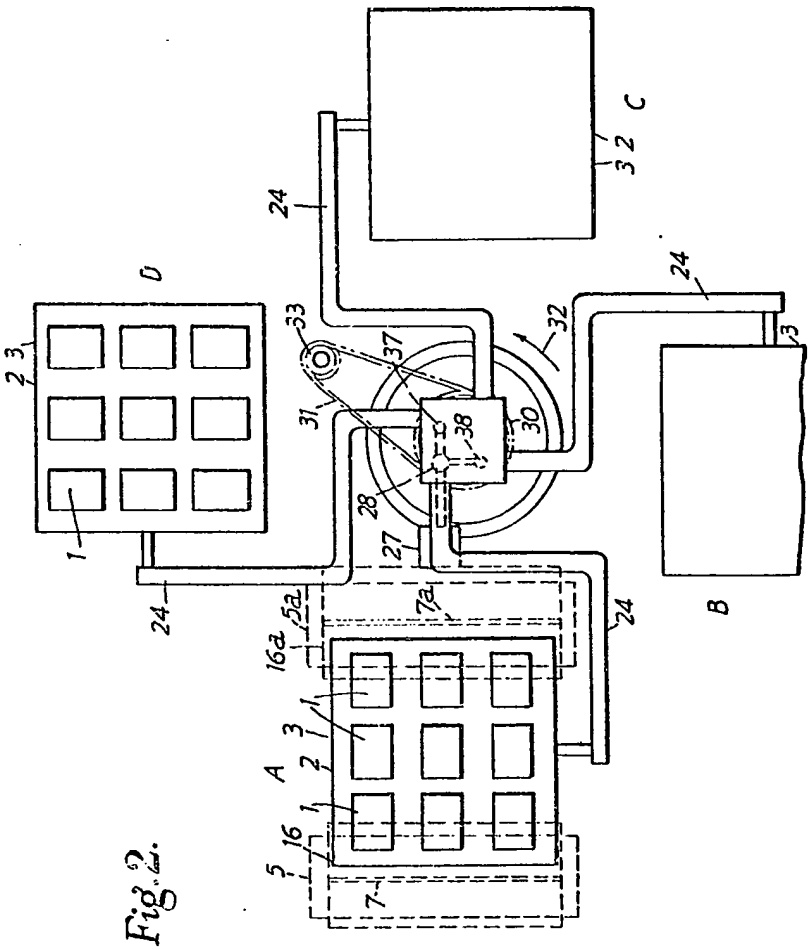

Fig. 2.

Fig.3.

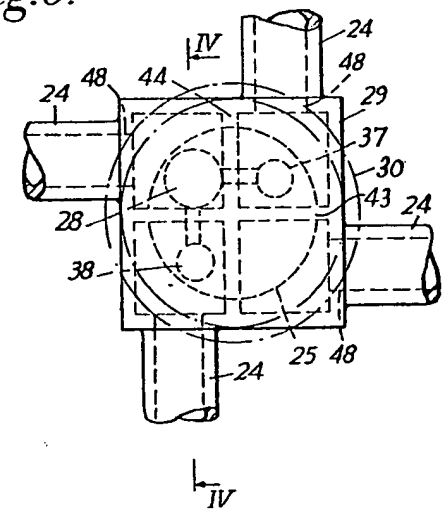
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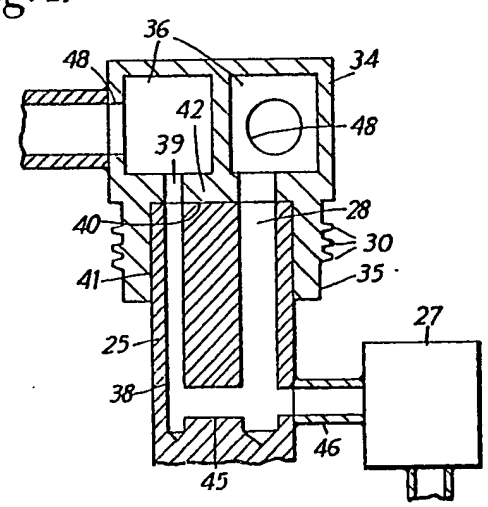
Fig.4.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